Wind power and the power market

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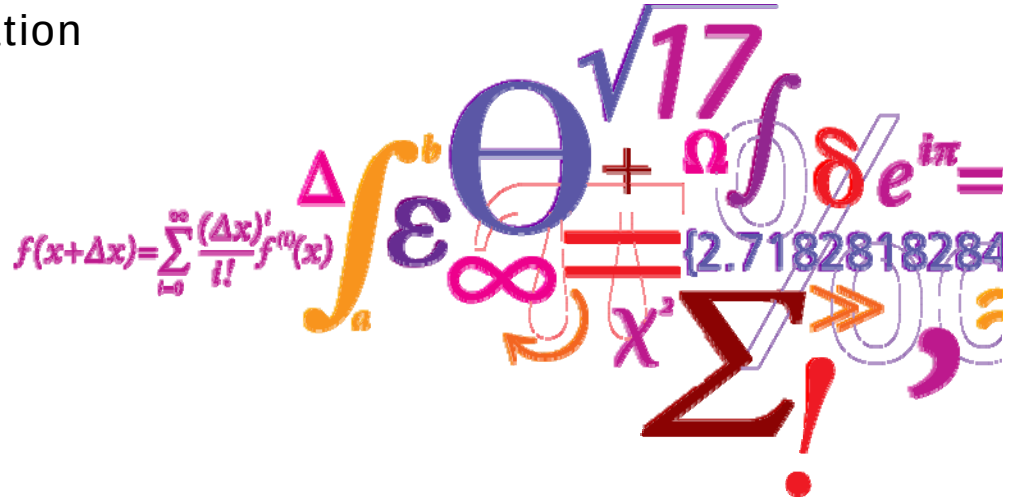
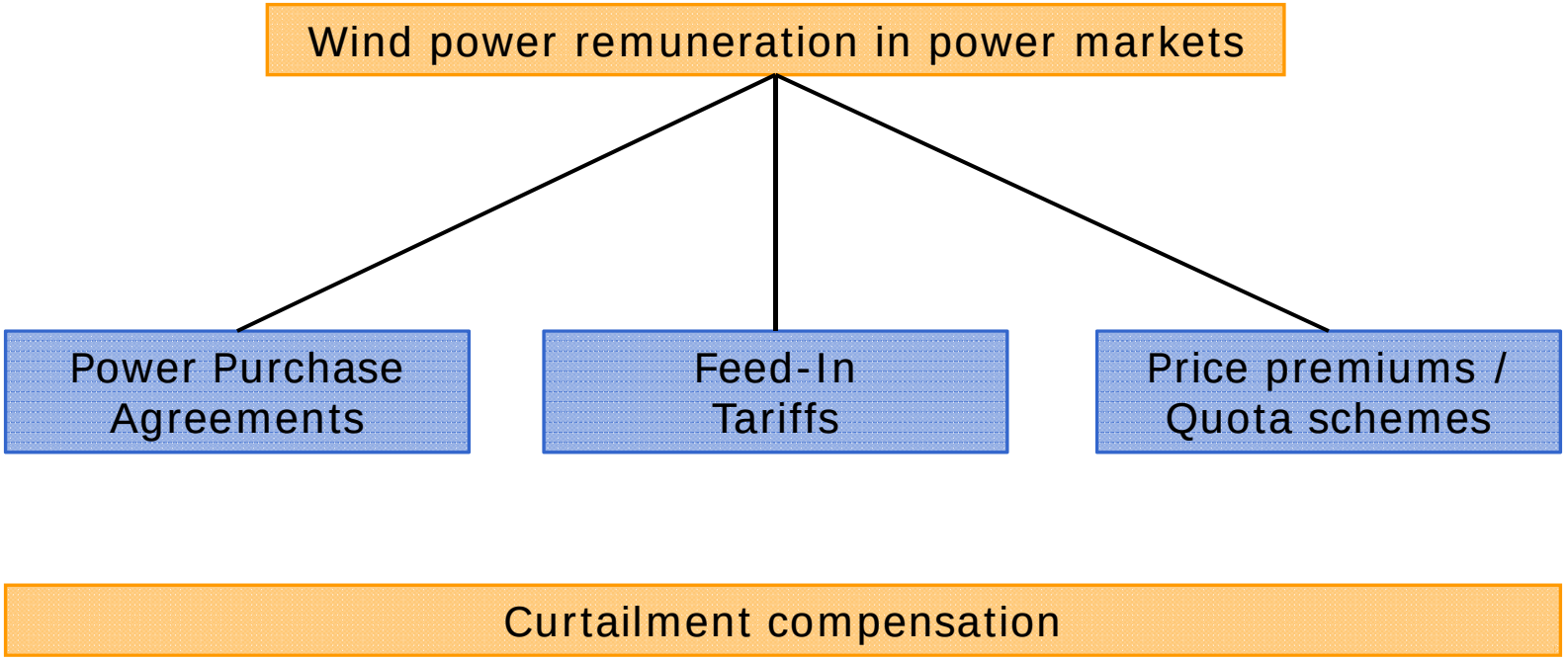


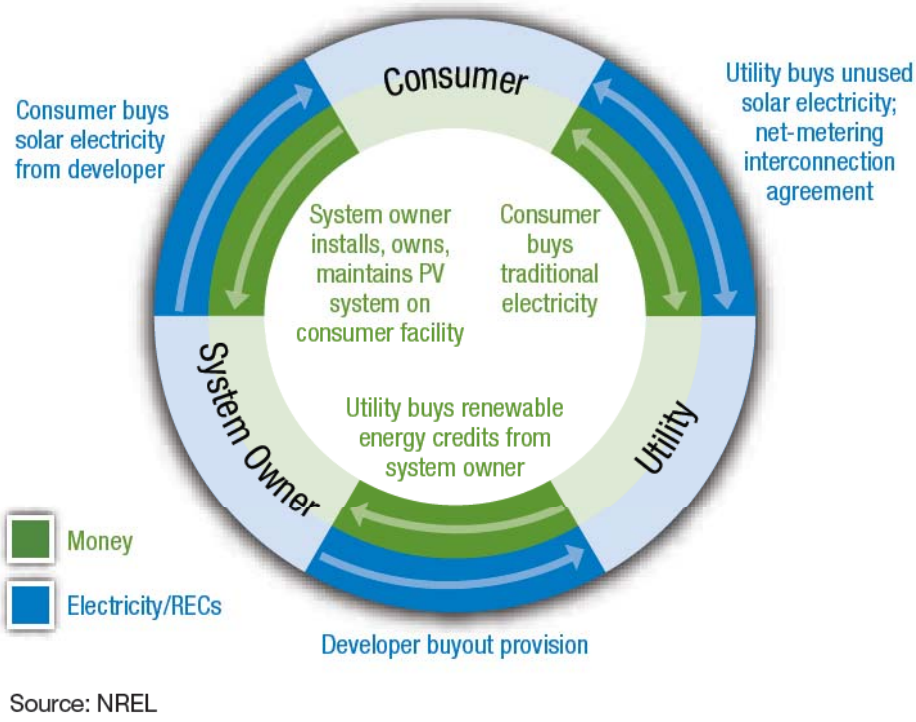
DTU Management Engineering
Department of Management Engineering

Outline


Wind power remuneration in power markets
Power Purchase Agreements
Feed-In Tariffs
Price premiums / Quota schemes
Curtailment compensation

Power Purchase Agreements – Definition

Criterion
Duration
Tariff •fixed price/kWh •fixed escalator price/kWh
Financing •attractive if increasing tariff rates are expected •combination with net metering •comparatively positive impact on network •transaction costs: favours larger projects

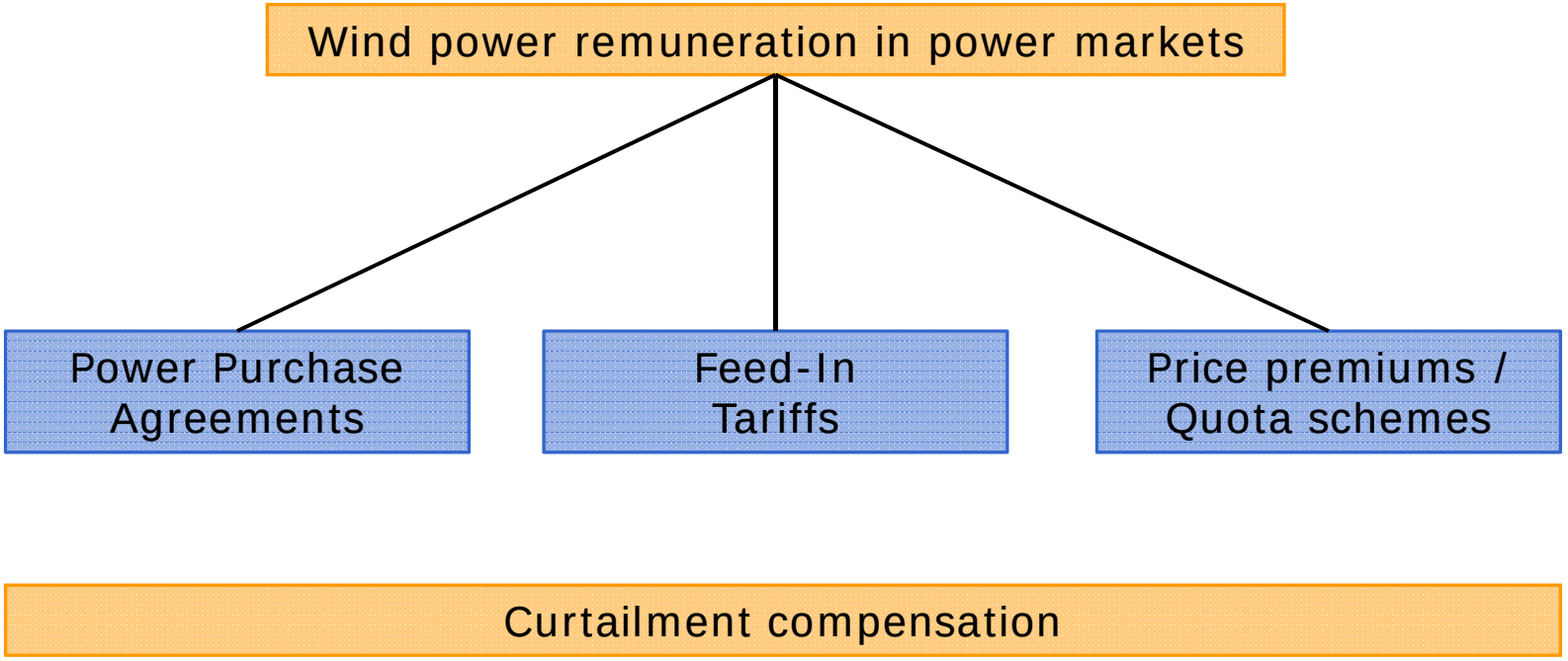


Source: NREL

Power Purchase Agreements – Best practice

Criterion	Best practice
Duration	e.g. 15, 20 or 25 years
Tariff •fixed price/kWh •fixed escalator price/kWh	escalator e.g. driven by inflation or expected tariff increases
Financing •attractive if increasing tariff rates are expected •combination with net metering •comparatively positive impact on network •transaction costs: favours larger projects	•provide planning security to project developers! •for small-scale applications •set locational incentives and publish them, if possible •shallow connection charges: project developer pays only equipment to connection point

Outline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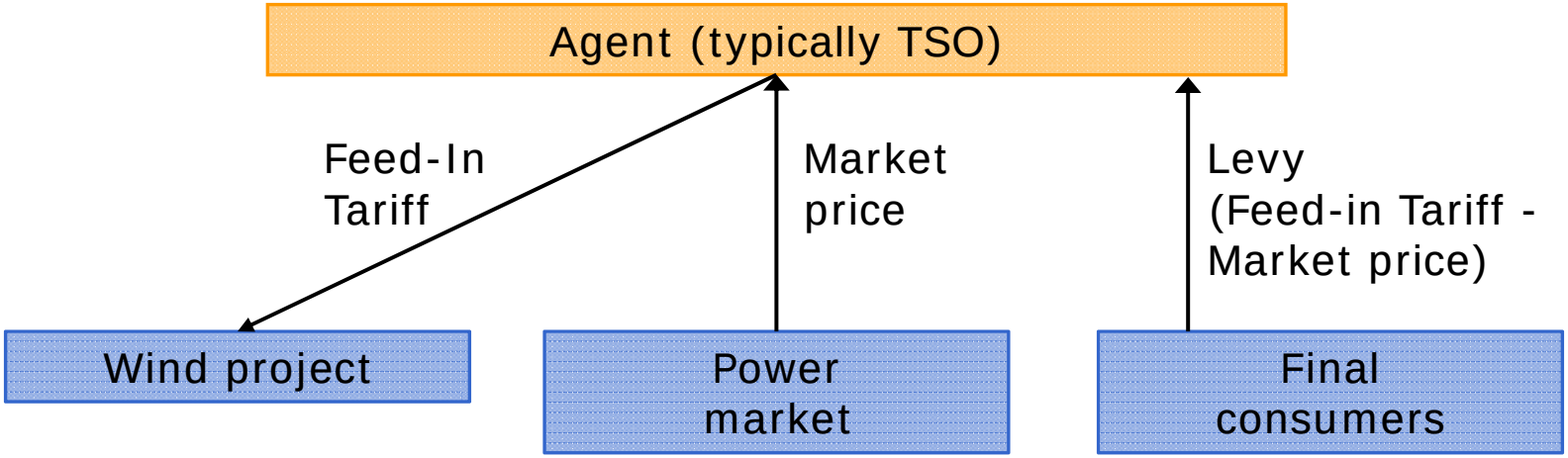
Feed-In Tariffs

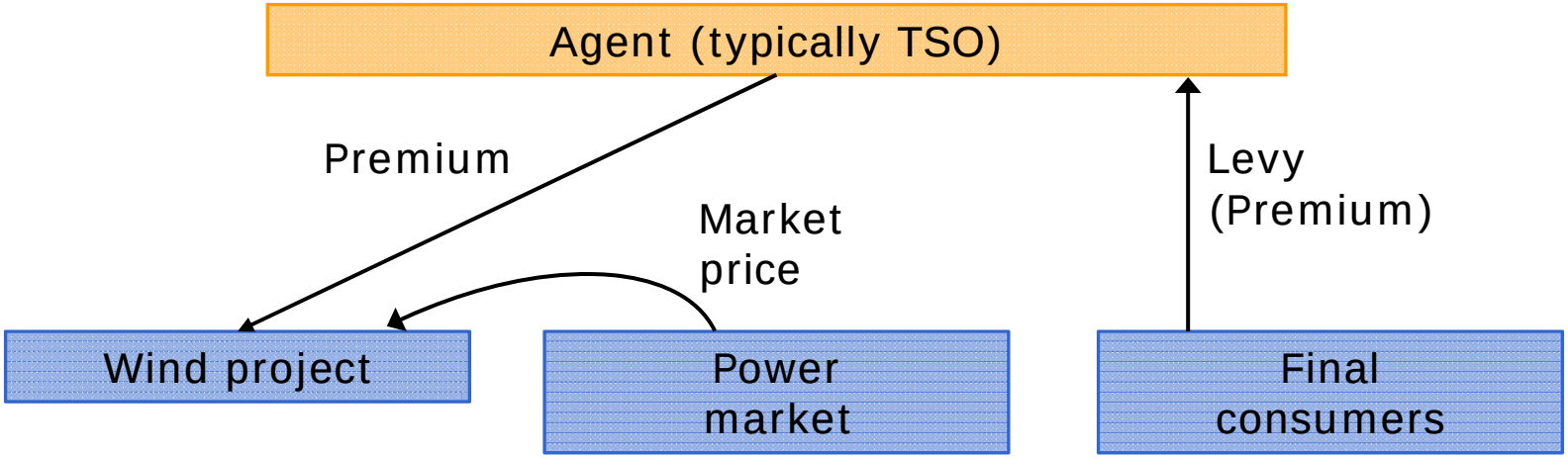
- fixed tariff/kWh over specific time period



- fit for early and mid-penetration markets
- balancing of forecast errors done centrally by TSO
  - good tools, multiple tools combined
- technical connection rules (network stability) adjusted for wind penetration level
- locational incentives could be set via connection charges – but keep them shallow

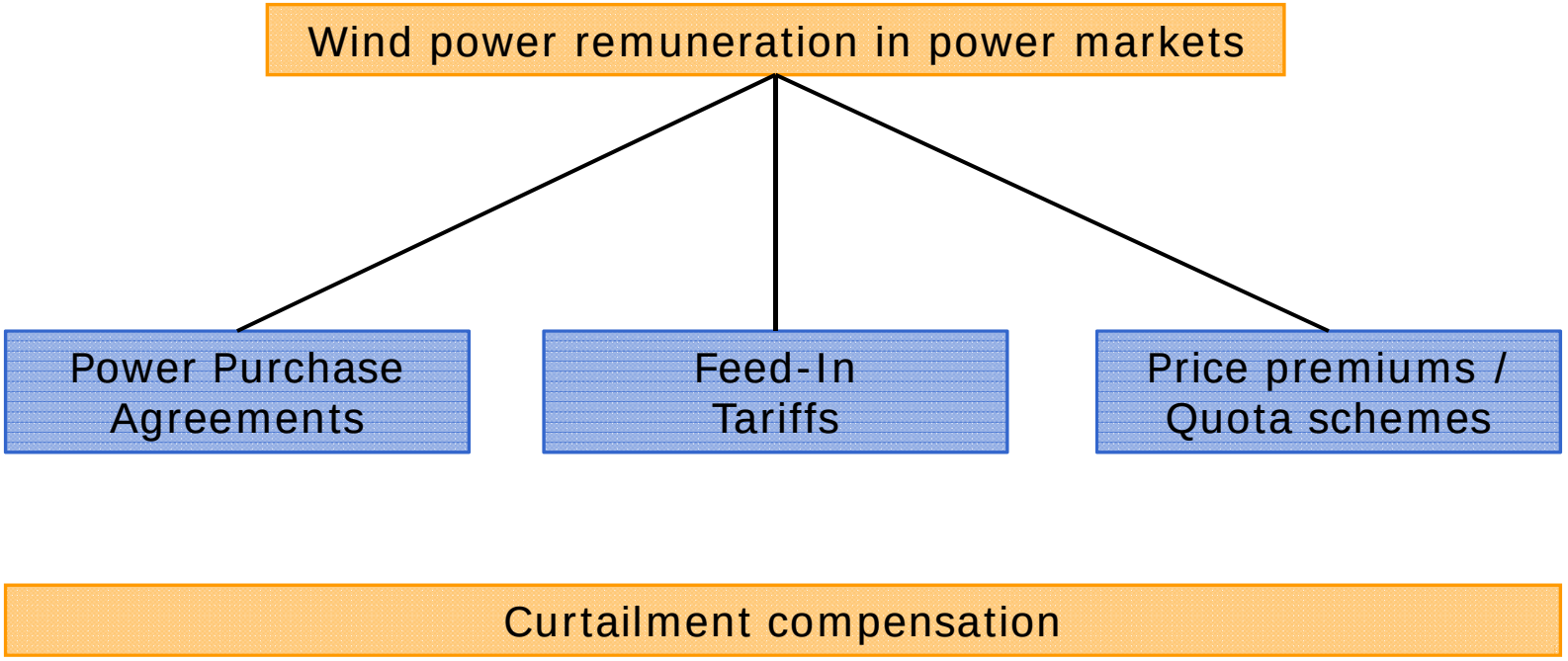
Price premiums / quota schemes

- fixed premium/kWh or variable quota price/kWh over specific time period



- fit for mature markets and high penetration levels
- risk premiums from developers' point of view
- balancing of forecast errors done centrally by single actors
- technical connection rules (network stability) adjusted for wind penetration level
- locational incentives could be set via connection charges – but keep them shallow

Outline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Curtailment

- 2 types of curtailment
  - involuntary: reduced generation due to e.g. grid problems
  - voluntary: reduced generation due to power market signals

- static conditions: network capacity that can absorb all generation is overdimensioned (e.g. offshore)
- contractual agreement on a maximum number of curtailment hours possible
  - part of a PPA / network connection agreement
  - also as locational signal
  - otherwise: compensation at outgone income level
  - curtailment agreements need to be regulated

Food for thought & discussion

- connection conditions: transparent & forseeable, technical specifications adjusted to wind penetration level
- Power Purchase Agreements
  - value of power
  - insurance function against rising fuel prices
  - impact on network, possible impact after network extensions
- General:
  - proactive approach to wind integration
  - shallow connection charges
  - optimal curtailment level
  - curtailment compensation

Thank you for your attention!

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